

# THE ART AND SCIENCE OF IDENTIFYING FLOOD ZONES

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Are you planning to develop oceanfront property? Are you responsible for coastal floodplain management? If so, whether you are a coastal developer, geologist, building inspector, or conservation commissioner, you will want to familiarize yourself with how to accurately define the extent of flood zones. In some cases, it is not as simple as reading the latest Flood Insurance Rate Map (FIRM) from the Federal Emergency Management Agency (FEMA). Although this article targets people with experience in these issues, coastal property-owners or potential buyers should be aware that flood zone maps do not always tell the whole story.

## FLOOD ZONES DEFINED

The two primary types of flood zones (or special flood hazard areas) included in the Massachusetts Wetlands Protection Act regulations as Land Subject to Coastal Storm Flowage are velocity zones and A-zones. Velocity flood zones, also known as V-zones or coastal high hazard areas, have been identified by FEMA as areas “where wave action and/or high velocity water can cause structural damage in the 100-year flood,” a flood with a 1-percent chance of occurring or being exceeded in a given year (See *100 Year Floods Don't Come on Schedule*, on page 15). Because of this

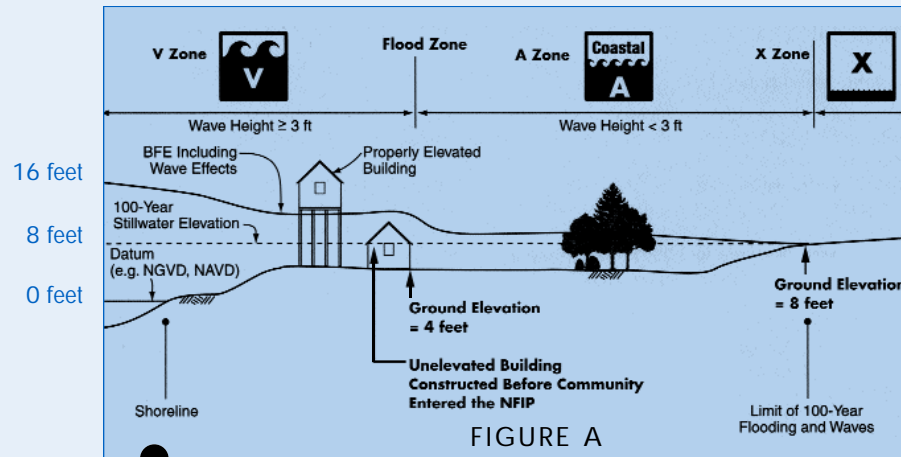
potential for damage, stringent regulatory requirements seek to ensure that work and construction in V-zones will minimize environmental and structural impacts, as well as economic loss. A-zones are areas inundated in a 100-year storm event that experience conditions of less severity than conditions experienced in V-zones, for example, wave heights less than 3 feet. Since FEMA flood zones may experience dangerous storm-generated wave action and surges, an accurate determination of the spatial extent of these zones is vital to understanding the level of risk for a particular property or activity.

## USING FIRMS TO IDENTIFY FLOOD ZONES

The first step in determining if a property is in a flood zone is to examine the most up-to-date FIRM. FIRMs, as well as Flood Insurance Study reports, are available from FEMA for a nominal fee by calling the Map Service Center at 1-800-358-9616 or by ordering on-line at <http://msc.fema.gov/MSK>. Also, they can usually be viewed at local government offices, such as the building inspector, planning board, and conservation commission.

The base flood elevation (BFE) for a flood zone is the level that flood waters are calculated to reach during a 100-year event. This value is usually printed on a FIRM for each coastal flood zone. FIRM elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD), except for Nantucket, which is referenced to the Half Tide Level Datum of 1934. If your project plan does not use NGVD, convert to a consistent datum. Please note that for V-zones, the BFE is not necessarily a ground elevation. As seen in Figure A, although the BFE for the seaward portion of this V-zone is 16 feet, the velocity conditions do not reach as far landward as the 16-foot ground elevation. Instead, as waves break and wave heights diminish in the landward direction, the BFE is reduced.

In general, to delineate specific A-zones, identify the BFE on the FIRM and locate it on the corresponding topographic contour on the project plan (remembering to convert datums if necessary). To delineate V-zones, scale the zone boundary from a known, fixed point, such as a benchmark or road intersection (if scaling from a road on the FIRM, use the center of the road since the lines do not



BFE = BASE FLOOD ELEVATION

NFIP = NATIONAL FLOOD INSURANCE PROGRAM

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accurately represent road edges), or, at the same scale, overlay the FIRM onto the project plans and trace the zone boundary. When scaling, do not use a shoreline location as a reference point since its position may change over time.

Due to limitations associated with the scale of flood zone mapping, actual V-zone conditions may not match the FIRM boundary for a specific site. Therefore, site topography, land-form type, and nearby transect data from the local FEMA Flood Insurance Study may need to be considered in delineating V-zones for planning purposes. When a detailed study of site conditions is necessary, those without extensive background in flood zone mapping are advised to consult with a professional.

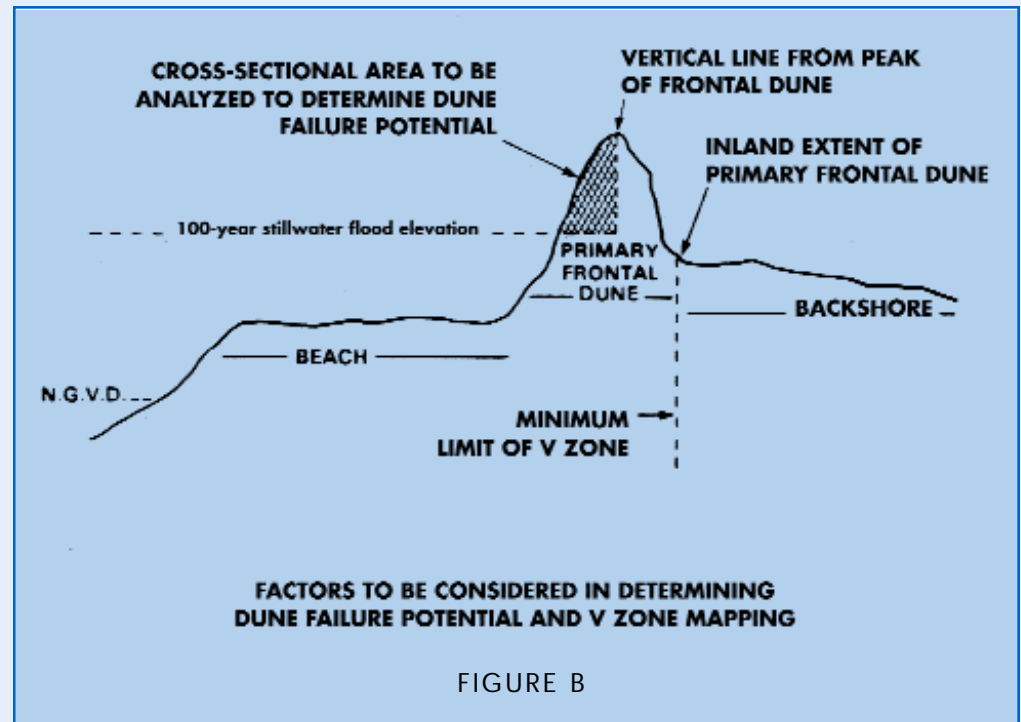
#### COASTAL SAND DUNES—A SPECIAL CIRCUMSTANCE

For sites partially or completely within a coastal sand dune, the FIRM may not give the complete answer as to the extent of the flood zone. FEMA recognizes that their original mapping oversimplified the flood zone/sand dune issue by not taking into account erosion and associated wave runup (the rush of the breaking wave). During a coastal storm, sand dunes often erode, providing sediment to the coastal beach and nearshore areas. Depending on the original dune volume, the coastal sand dune may be overtopped or eroded completely resulting in velocity conditions and wave action that extend farther landward than depicted on the FIRM. In 1988, FEMA revised the National Flood Insurance Program (NFIP) regulations, specifically Title 44, Code of Federal Regulations, Section 65.11, Evaluation of sand dunes in mapping coastal flood hazard areas to address this issue. However, due to budgetary constraints, even FIRMs dated post-1988

generally do not reflect these regulatory changes. In most cases, the only recent update involved the addition of Coastal Barrier Resource Units in 1992. Any revisions made since the original maps were created are listed under the legend provided with each FIRM.

These updated NFIP regulations define a V-zone or coastal high hazard area as an “area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources.” Due to the dynamic nature and erosion potential of primary frontal dunes, such as changes in shoreline configuration from the impact of consecutive storms, “the final rule definition of coastal high hazard area includes all primary frontal dunes. Therefore, the boundary line of the V-zone, at a minimum becomes the landward ‘toe’ of the dune.” (*Federal Register*, May 6, 1988)

In some cases, the V-zone may extend farther landward than the inland limit of the primary dune. Section 65.11 (b) of the NFIP regulations indicates that “primary frontal dunes will not be considered as effective barriers to base flood storm surges and associated wave action where the cross-sectional area of the primary frontal dune, as measured perpendicular to the shoreline and above the 100-year stillwater flood elevation and seaward



of the dune crest, is equal to, or less than, 540 square feet.” Figure B demonstrates how the 540 square foot area is measured.

FEMA provides further clarification of this “540-rule” in its 1995 *Guidelines and Specifications for Wave Elevation Determination and V Zone Mapping*. Although a dune with a cross-sectional area greater than 540 square feet may provide some level of protection during the 100-year event, by definition the V-zone still includes the entire primary frontal dune. Further analysis is necessary to establish the landward edge of the V-zone if the dune will be overtopped and/or if the cross-sectional area of the primary dune is less than 540 square feet. When the cross-sectional area of the primary dune is less than 540 square feet, the additional analysis involves assuming the dune is removed by erosion during the storm event, and assessing the results of wave

runup models to determine how far inland velocity conditions would extend. The FEMA Guidelines provide methodology for evaluating site-specific conditions and delineating V-zones in sand dunes.

Why 540 square feet? FEMA's assessment of dune erosion is based on a statistical analysis of erosion data from actual storm events of different severities. FEMA graphed the cross-sectional area that was eroded from the primary dunes during various coastal storms, then determined the median value of erosion for the data set. For 100-year storms, the median area of erosion was 540 square feet. Using the median means that in 50 percent of the cases, less than 540 square feet is eroded, while more than 540 square feet is eroded in the other 50 percent of the cases. In addition, this analysis does not account for cumulative impacts from multiple storms and long-term erosion. The recent revision of FEMA's *Coastal Construction Manual* (CCM) addresses these limitations by recommending that a more conservative primary frontal dune measure of 1,100 square feet be used for planning purposes.

In addition to updating the methodology used to identify coastal high hazard areas, FEMA has also provided additional guidance for development in A-zones that may experience coastal storm flooding. A-zones in coastal settings are identified as "Coastal A-zones" in the revised CCM. Although Coastal A-zones experience forces less severe than V-zones, they may still be subject to velocity and wave-related storm conditions capable of causing damage. Therefore, FEMA encourages the application of certain V-zone regulatory requirements within these areas, such as the elevation of new or substantially improved dwellings on open pile foundations.

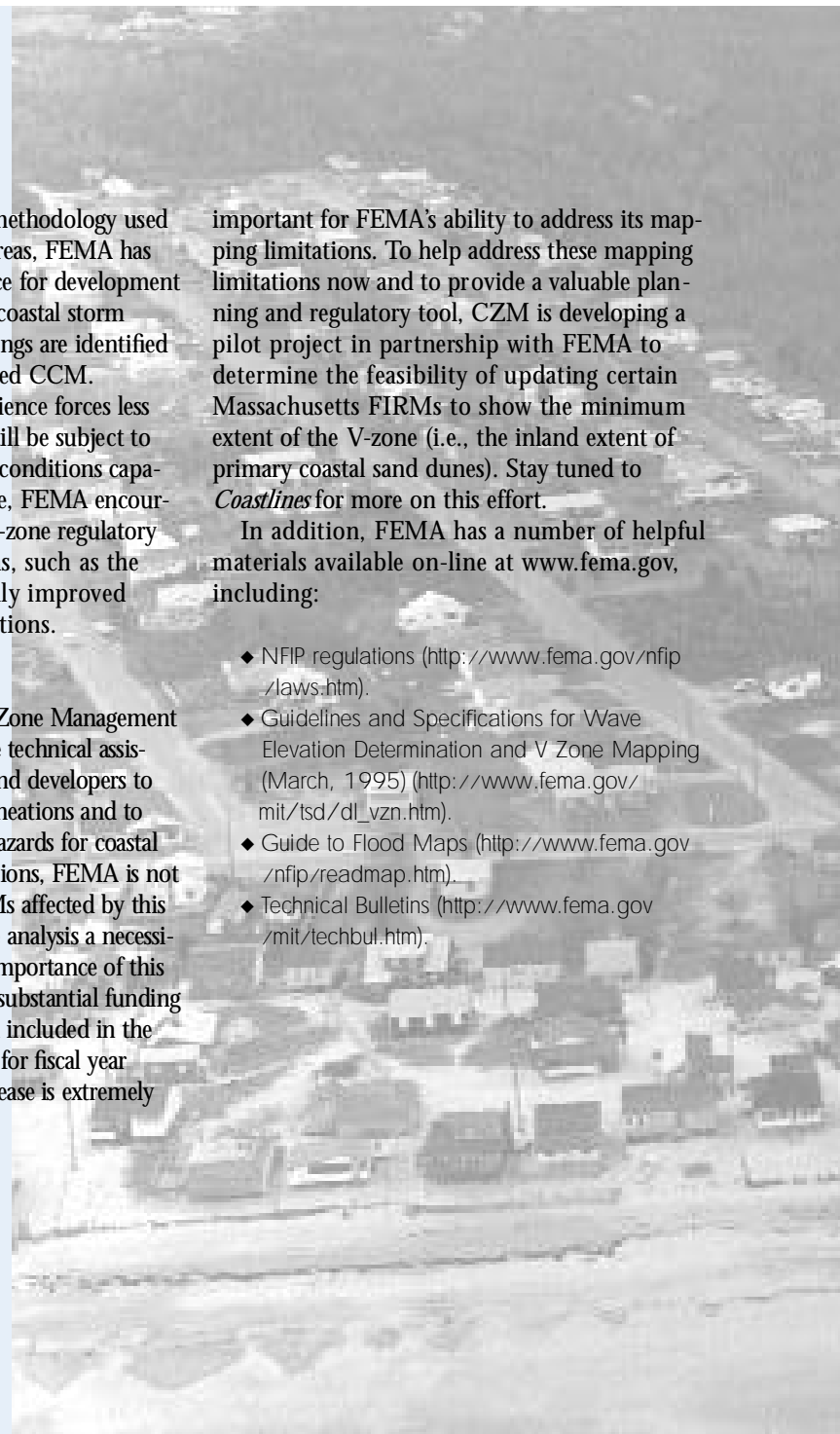
#### NEED MORE HELP?

Massachusetts Office of Coastal Zone Management (CZM) coastal geologists provide technical assistance to local coastal regulators and developers to facilitate accurate flood zone delineations and to better assess potential risks and hazards for coastal properties. Due to budget limitations, FEMA is not currently able to update all FIRMs affected by this issue, making detailed site-by-site analysis a necessity. It appears, however, that the importance of this issue has been recognized by the substantial funding increase to the mapping program included in the recently proposed federal budget for fiscal year 2003. Passage of this budget increase is extremely

important for FEMA's ability to address its mapping limitations. To help address these mapping limitations now and to provide a valuable planning and regulatory tool, CZM is developing a pilot project in partnership with FEMA to determine the feasibility of updating certain Massachusetts FIRMs to show the minimum extent of the V-zone (i.e., the inland extent of primary coastal sand dunes). Stay tuned to *Coastlines* for more on this effort.

In addition, FEMA has a number of helpful materials available on-line at [www.fema.gov](http://www.fema.gov), including:

- ◆ NFIP regulations (<http://www.fema.gov/nfip/laws.htm>).
- ◆ Guidelines and Specifications for Wave Elevation Determination and V Zone Mapping (March, 1995) ([http://www.fema.gov/mit/tsd/dl\\_vzn.htm](http://www.fema.gov/mit/tsd/dl_vzn.htm)).
- ◆ Guide to Flood Maps (<http://www.fema.gov/nfip/readmap.htm>).
- ◆ Technical Bulletins (<http://www.fema.gov/mit/techbul.htm>).





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